isoflurane is fairly rapid at 1 percent to 4 percent inspired concentration. This agent has mild pungency, which may limit the rate of induction in some patients, although excessive salivation or tracheobronchial secretions do not appear to be stimulated. The depth of anesthesia can be easily altered by controlling the inspired anesthetic concentration. Recovery from anesthesia is usually smooth and rapid, and no significant incidence of nausea or vomiting has been observed.

Anesthesia is maintained with 0.8 percent to 2 percent inspired concentration of isoflurane. The agent is a potent respiratory depressant and, hence, respiratory status needs to be closely monitored and supported when necessary. This depression is partially reversed by surgical stimulation. Systemic blood pressure decreases with induction of anesthesia as a result of a decline in the peripheral vascular resistance, an effect similar to that of enflurane and halothane. Blood pressure returns toward normal values on commencement of the surgical stimulation. With regard to its cardiac effects, isoflurane is superior to both enflurane and halothane because it does not decrease myocardial function or cardiac output during moderate depth of anesthesia. Isoflurane does not appear to sensitize the myocardium to catecholamines (epinephrine). There is a modest increase in heart rate under isoflurane, irrespective of the anesthetic concentration. This effect is in contrast to that of enflurane, which produces a dose-related increase in heart rate and that of halothane, which causes no increase in heart rate. Isoflurane is free from the central nervous system excitatory properties of its isomer, enflurane. It produces excellent muscle relaxation as does enflurane, is roughly two to three times more effective than halothane, and greatly potentiates all muscle relaxants.

Of all the halogenated anesthetic agents, isoflurane is the least metabolized in humans or animals. This relative stability strongly indicates that the agent should have no potential to produce organ toxicity. Studies carried out in humans and animals also suggest little or no effect on the liver or kidney, and there is no evidence to indicate the carcinogenicity of isoflurane.

Isoflurane claims superiority over several other inhalation anesthetics for its effect on the cardiovascular system, the central nervous system, the neuromuscular system, anesthetic metabolism and organ toxicity. Its drawbacks include a pungent smell, considerable respiratory depression, tachycardia and hypotension. The full potency of this anesthetic agent will not be known until it is administered to several thousand patients for various surgical procedures. Isoflurane is not perfect, but it comes one step closer to being an ideal inhalation anesthetic agent.

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The Role of Ketamine in Obstetric Anesthesia

DESPITE INITIAL FAVORABLE EVALUATION of therapy with low doses of ketamine (0.5 mg per kg of body weight) in obstetric patients, the drug has not been widely used during delivery for two reasons: First, several subsequent investigators showed significant neonatal depression with higher doses (2 to 5 mg per kg of body weight) of the drug. Although later evidence showed that low doses (0.2 to 0.4 mg per kg of body weight) did not have a substantial depressant effect on newborn infants, the decline in ketamine's use caused by the earlier results persisted. Second, there is a growing, and laudable, trend away from the use of general anesthesia in obstetrics. Consequently, there is no indication for the large doses of ketamine (1 to 2 mg per kg of body weight) used to induce general anesthesia.

Ketamine is becoming more popular as an intravenously administered *analgesic* for the second and third stages of labor. When very low doses of the drug are given women for whom regional or inhalational methods of analgesia are unsuitable, consciousness and patient cooperation are maintained and relief of pain is excellent. Because the mother retains her protective airway reflexes, endotracheal intubation is not required, and high flows of oxygen can be administered by face mask. Some of the other problems often associated with larger doses of ketamine are not seen with the low-dose technique. For example, hypertension and tachycardia occur only rarely, and bad dreams or hallucinations are similarly infrequent.

Two intravenous doses of 5 to 10 mg of

ketamine usually will provide sufficient analgesia for a normal, uncomplicated vaginal delivery. Administration of bilateral pudendal nerve blocks or perineal local infiltration will further enhance the effects of the analgesia and will obviate the need for repeated injections during the second and third stages of labor.

Doses of ketamine larger than 1 mg per kg of body weight can have negative effects on the newborn and should, therefore, be avoided in obstetric care. However, very low doses (0.1 to 0.2 mg per kg of body weight) given intravenously provide effective analgesia for the second and third stages of labor without causing significant complications in the mother or infant.

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Issues in Obstetric Anesthesia

THREE NOTEWORTHY ISSUES in the use of anesthesia in obstetric patients are (1) continuous-infusion epidural analgesic agents, (2) the safety of 2-chloroprocaine and (3) the neurobehavioral consequences of epidural anesthesia in newborns.

Continuous-infusion epidural analgesia has recently gained wider acceptance as an efficient tool for regional anesthesia because it allows sophisticated anesthesia to be given safely and efficiently to a larger number of women who are in labor. Bupivacaine, 0.25 percent, is infused in a volume of 6 to 12 ml per hour by constant infusion pump after safe placement of an epidural catheter and response to the drug has been confirmed. Care of the patient includes half-hourly blood pressure measurement and leg lift test to avoid motor blockade. The result is a steady level of analgesia with fewer peaks and valleys of pain, less sympathetic block, less motor loss and lower peak blood levels of bupivacaine than are often seen with intermittent injection.

There have been recent case reports of neural damage after subarachnoid injection of 2-chloroprocaine, although results of numerous studies in the United States have shown that 2-chloroprocaine is no more toxic than other local anesthetic agents. Large-scale statistical comparisons of epidural anesthetic administration in humans have shown an incidence of neurological injury of 1 in 11,000.

Laboratory animal preparations of nerves exposed to local anesthetic solutions have been compared. Prolonged exposure of mammalian nerves to chloroprocaine produced no evidence of nerve injury. Most physicians who use this agent and the Food and Drug Administration as of December, 1980, agree that 2-chloroprocaine is safe for use in obstetric patients. The advantages of rapid onset, short duration, short plasma half-life and minimal placental transfer justify its continued use as an alternative drug in regional anesthesia.

Results of controversial studies have indicated that obstetric anesthesia may cause brain damage in some newborn infants. The validity of these assertions has been recently challenged by neonatal behavioral scoring techniques, including Brazleton, Scanlon and the newer ABS (Amiel-Tison, Barrier and Shnider). Hodgkinson, Scanlon and others have found no measurable differences in neonatal scores between babies delivered with or without epidural bupivacaine. This conclusion applies equally to babies born by vaginal delivery and by cesarean section. A good result depends on a high standard of anesthetic care, parsimonious anesthetic dosages and promotion of maternal cardiovascular and respiratory well-being.

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Aminophylline, Arrhythmias and Anesthesia

AMINOPHYLLINE (theophylline ethylenediamine) is the most widely used bronchodilator in the United States. Frequently, it is given preoperatively to asthmatic patients before the anesthetic is administered as well as intraoperatively for the treatment of bronchospasm. Halothane is considered the anesthetic agent of choice for asthmatic patients because of its bronchodilating effect.

There have been no reports of cardiac arrhythmias occurring in patients following intraoperative